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Research Article

Effects of the Different Levels of Flour (Passiflora edulis), the European and Economic Efficiency Index on Performance of the Cobb 500 Chickens

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Abstract

In the present work, the inclusion of Passion Fruit Flour (*Passiflora edulis*) in three levels and a control on the zootechnical parameters in broiler feed was evaluated. The trial lasted 42 days and 4 diets were evaluated 0%, 3%, 6%, 9% passion fruit flour. 200 Cobb 500 day-old chicks were used, arranged in 4 treatments and 5 repetitions with 10 birds per experimental unit. Diets were formulated for each treatment (T0, T1, T2, T3) and for each stage (initial, growth, fattening). The data is processed in the information and the results. in the initial stage, the T0 treatments (0% passion fruit flour), and T1 (3% passion fruit flour) are statistically equal and the passion fruit flour can be used in this percentage without affecting the zootechnical parameters as an alternative to the raw material The T2 treatments (6% passion fruit flour) and T3 (9% passion fruit flour) are statistically different in this regard and have negative effects on production rates and are not recommended for this stage. use passion fruit flour at these levels; in the stages (starter, grower and finisher) it is a statistical program Infostat (2015). the T1 treatments (3% passion fruit flour) and T2 (6% passion fruit flour) are ineffective to the control T0 (0% passion fruit flour), and do not influence the zootechnical parameters in the growth and fattening stage, determining that the revenge production costs; 2.4% production costs; The T3 treatment (9% passion fruit flour) is significantly different from the other treatments. It is recommended the development of diets up to 6% without affecting the zootechnical indexes.

Keywords: *Flour; Passion Fruit; Growth; Inclusion; Parameters; Costs*

Introduction

Among the most important livestock activities in Ecuador is poultry farming, which is equivalent to approximately 13% of agricultural GDP in 2012, with a per capita consumption of chicken meat of 32 kg/year, the supply of chicken meat to market is 100% national production, implying a high demand of raw materials for the feeding of birds; This represents up to 70% of the total production costs, which is why we are constantly looking for viable alternatives to reduce these costs and improve profitability (Conave, 2015).

Traditionally, soybeans and corn are the main raw materials for the production of balanced products, but since they are products that are also required for human consumption, their availability in the market is unstable and their costs are high. Finally, transnational companies store large quantities, leaving small producers without these raw materials and raising the price (Conave, 2015).

The processes in the food industry bring as a consequence a series of organic waste, increasing the level of environmental contamination of the place where food is processed. These drawbacks generate the need to direct these by-products to other uses, for which laboratory and field studies must be carried out until finding the suitable area where they can be used, even more if they have high nutritional contents such as protein, energy, fat, fiber and the majority of minerals, such as the fruit of maracuya, which is produced in its entirety on a national level and as the objective of its production are beverages and extracts, most of the fruit remains unused; This apparent "waste" through a small process of drying and grinding is transformed into passion fruit flour, obtaining a raw material with excellent texture, good palatability and at a very low cost [1].

This product is intended for the feeding of animals, especially ruminants; obtaining excellent results in these species [2], other studies were conducted in guinea pigs achieving positive results [3], laying hens tested the inclusion of passion fruit flour at 0%, 2.5% and 5% with similar results to the witness [4]. In the Federal University of Cariri, in the city of Brasilia; The performance of slow-growing broiler chickens fed with pineapple, cashew and passion fruit by-products was analyzed to replace 10% corn feed. We acquired 240 1-day-old chicks, females and males, naked neck. The birds were distributed in a completely randomized design with four (4) treatments and five (5) repetitions of twelve (12) birds each, for a total of 60 chicks per treatment. For consumption, food, waste, weight gain and feed conversion of the fed birds did not differ significantly from those who received the control diet. The substitution of 10% of the maize for pineapple, cashew and passion fruit residues in the diet does not affect the performance of broilers until 70 days of age [5,6].

In the Poultry Program of the ESPOCH School of Animal Sciences, a study was conducted on laying hens Lohmann Brown, using two levels of passion fruit cake (2.50 and 5.00%) plus exogenous enzymes versus a control and its effect on the production stage of laying. In the investigation, 480 chickens were used, which consisted of 20 birds for each EU, with 4 repetitions per treatment. The results were analyzed under a completely randomized design, for which the Infostat statistical program was used. The control treatment registered the highest amount of food consumed 118g, as well as a better production 78.52%, and a better egg mass 50.26g, however the feed conversion did not register statistical differences. Finally, the best digestibility is achieved with 5% passion fruit cake with enzymes obtaining 69.92%. The best cost benefit was obtained when using the control treatment with and without enzymes whose indicator was 1.15 and 1.14 respectively [4].

Experiments carried out in the porcine sector of the experimental farm Iguatemi, property of the Center of Agricultural Sciences of the State University of Maringa, allowed to analyze the yields of the fruit of maracuya; a by-product from the extraction of passion fruit pulp that can be used to feed pigs. Two experiments were carried out (digestibility and yield) to evaluate the use of passion fruit flour in the feeding of growing and fattening pigs. A digestibility test was carried out with pigs in the growing and fattening stage, in which passion fruit seed flour replaced the reference diet 0% passionfruit fruit at the levels of 4, 8, 12 and 16%. The fruit seed of The metabolizable energy of passion fruit seed flour was estimated at 3588.5 kcal/kg. The inclusion of at any level did not affect the average daily gain, daily feed intake, feed/gain ratio, dorsal fat thickness, loin depth, and plasma or blood components. It is concluded that the passion fruit seed meal in pigs, in the initial phase can be added up to 16% in the diet without any negative effect on the growth, carcass and blood characteristics in the pigs of commercial lines of fattening [7].

The Cobb 500 broiler chicken is white plumage, white legs, with a low feed conversion, a better growth rate and an ability to thrive at high densities, with lower nutrition costs. Therefore, lower cost per kilo of live weight produced is obtained [8]. The present investigation was carried out to evaluate if this product has favorable results in diets for fattening birds; for this, different levels of inclusion in the diet have been selected, which allowed to determine the effect of passion fruit flour (*Passiflora edulis*) on the zootechnical parameters in broiler feed.

Materials and Methods

The present investigation was carried out in the Parroquia Antonio José Holguín belonging to the Salcedo canton, of the Province of Cotopaxi, at an altitude of 2670 meters above sea level, located in the following Geographical Coordinates: Latitude 01º105,55, S 78º35,33, W, Longitude 78º 18` 59''W. The experiment was conducted under controlled environment conditions (shed), the characteristics of the climate are the following: minimum temperature 8ºC, maximum 20ºC, and average of 14ºC, with rainfall of 539 mm per year, the hottest month of the year with an average of 15.6°C is January, the coldest month of the year 12.9°C is August, the average relative humidity is between 50 - 60%, [9].

Regarding the equipment and materials, 200 one-day-old chickens were used, with an average weight of 41.7 gr, materials such as passion fruit flour (diets), feeders, drinking troughs, plastic tanks, gas heaters, chaff were used of rice, cleaning materials, vaccines and probiotics. In addition, we used a scale of 5 kg (1gr), 100 kg (10g). The factors under study were:

- T0: 0% passion fruit flour (*Passiflora edulis*).
- T1: 3% passion fruit flour (*Passiflora edulis*).
- T2: 6% passion fruit flour (*Passiflora edulis*).
- T3: 9% passion fruit flour (*Passiflora edulis*).

The experiment was developed under the completely random design (D.C.A.), because the conditions are homogeneous. Four treatments and five repetitions were analyzed. Three of the treatments received inclusion of passion fruit flour at 3, 6, 9% respectively, plus a control treatment with 0% passion fruit flour.

Variation source	Degrees of freedom
Repetitions	4
Treatments	3
Experimental error	12
Total	19

Table 1: *Scheme of the experiment.*

Source: (Infostad, 2015).

For each treatment, the variance analysis (ADEVA) and Tukey significance tests were performed at 5%, to observe if there are statistically differences between treatments. For the response variables, weight gain of the animal was determined. Gr/day In this variable we proceeded to record the weight data at the beginning, weekly and accumulated at the end of the trial, and the feed conversion. Before the experiment, an analysis of the passion fruit flour was carried out in order to obtain exact data of the nutrients and be able to carry out the diet, yielding the following result.

For the experimental procedure, the formulation was made based on the requirements proposed by Rostango [10], according to age, the diets were elaborated in three stages, which are detailed below: As initial stage 0 - 14 days, stage of cultivator 15 -28 days, completion stage 29 - 42 days. The raw materials were purchased as soybeans at a price of $ 32 for 45 kg, corn for $ 17.50 for 40 kg, bran for $ 17 for 45 kg, oil for $ 54 for 60 kg and passionfruit flour for $ 10.90 for the 45 kg in the commercial "Valdiviezo" located in the lagoon sector of yambo, the different additives that were used for the formulation of the diets were acquired in "nutripharma".

Based on the formulations, the balance was calculated by calculating the consumption of the 200 birds for the 14 days of each stage according to the consumption table proposed by Vantress [8], for the Cobb 500 chicken, calculating 25 kg of feed per treatment in stage initial, 70 kg of feed per treatment for the growth stage and 98 kg of feed per treatment for the fattening stage; a vertical type mixer with a capacity of 500 kilograms was used, where the mixture of all the ingredients of each treatment was made.

In the house, two weeks before the arrival of the chicks, the divisions of the 20 cubicles where the experimental units had to be located were made. For this purpose, wooden sticks, nails, and canvas were needed for cubicle divisions, the area of each cubicle was 1.04 m^2, which would house 10 birds each, adhering to the proposal by Vantress [8], who states that it can accommodate up to 12 birds per m^2 with an average weight of 3 kg/bird; internal and external curtains were installed, incandescent lighting installations for each cubicle and placement of 4 gas heaters, then the cleaning and disinfection of the same was done and the rice chaff was placed with a bed thickness of 10 cm.

Manual feeders with a capacity of 2 kg were used, and gallon drinkers with a capacity of 2 liters, plus 4 bins of 50 kg/cu to store the food of each treatment and a tank of 100 liters to store the water. Prior to the arrival of the chicks, two hours before the heaters and incandescent bulbs were put into operation to obtain an internal temperature of the house of 32°C, recommended by Vantress [8], an ambient thermometer was used to measure the At the time of arrival of chicks, the weight was recorded and 10 birds were placed per experimental unit with periodic feed and water with electrolytes plus B vitamins, in addition to probiotics (electrovit).

Activities, each day before feeding the birds, the waste is collected, weighed and the values recorded in the record sheets, and in the same way the food that is to be supplied is weighed and recorded, water change, observes and regulates the temperature as proposed by Vantress C [8], handling temperatures in the first week with 32°C at the beginning and 30°C at the end of the week, for the second week it was handled between 30 and 28°C, the third week between 28 and 26°C, the fourth week between 26 and 23°C and in the following weeks, temperatures between 22 and 20°C were maintained. With respect to the sanitary calendar of vaccinated at three days for bronchitis, at 7 days was vaccinated against Gumboro and Newcastle.

As daily, it was repeated at 15 days these last two. For the processing of the information the statistical program Infostat (2015) was used.

Laboratory analysis

Before the experiment, an analysis of the passion fruit flour was carried out in order to obtain exact data of the nutrients and be able to carry out the diet, yielding the following result.

Requested test units result method used.

Requested	Test Units	Result	Method used
Ashes	%	1.88	PE14-5,4-FQ. AOAC Ed 19, 2012 923 03
Protein	% (Nx6.25)	16.3	PE16-5,4-FQ. AOAC Ed 19, 2012 2001.11
Humidity	%	6.25	PE15-5,4-FQ. AOAC Ed 19, 2012 925.10
Grease	%	9.93	PE17-5,4-FQ. AOAC Ed 19, 2012 2003.06
Raw fiber	%	35.1	INEN 522
Total carbohydrates	%	30.6	CÁLCULO
Energy	Kcal/100g	277	CÁLCULO

Table 2: *Proximal analysis of maracuya flour (Passiflora edulis).*

Source: LACONAL [11].

The formulation was made based on the requirements proposed by Rostango [10] and according to age the diets were elaborated in three stages, which are detailed below:

- Initial stage, 0 - 14 days.
- Growing stage, 15 - 28 days.
- Finishing stage, 29 - 42 days.

Materials were purchased as soy at a price of $ 32 for 45 kg, corn for $ 17.50 for 40 kg, $ 17 for 45 kg, oil for $ 60 for 60 kg and passion fruit flour for $ 10.90 for 45 kg in the commercial "Valdiviezo" located in the lagoon sector of yambo, the different additives that were used for the formulation of the diets were acquired in "nutripharma".

	Stages			
Raw Material	**Quantity H. M 0%**	**Quantity H. M 3%**	**Quantity H. M 6%**	**Quantity H. M 9%**
Soy Cake (47%)	%	27.62	27,16	26,8
Corn	24.49	63.58	60,40	56,77
Wheat Bran	59.48	0	0	0
Palm oil	9.7	2.56	3,15	4
Monocalcium phosphate	3.4	0.03	0	0,05
Calcium Carbonate	1.45	1.72	1,73	1,73
Iodized salt	0.23	0.25	0,25	0,25
DL - 99% methionine	0.10	0.12	0,13	0,13
Hcl - Lysine 78%	0.06	0.11	0,14	0,14
Molgard (A. propionic)	0.2	0.2	0,2	0,2
Salgard (A. formic)	0.15	0.15	0,15	0,15
Ultrabond (organic A.)	0.05	0.05	0,05	0,05
Premixture Vit. (broilers)	0.2	0.2	0,2	0,2
Chloride of Hill 60%	0.1	0.046	0,046	0,1
Rovabio max (enzymes)	0.05	0.05	0,05	0,05
Prozuril (coccidiostat)	0.02	0.02	0,02	0,02
Sodium bicarbonate	0.32	0.32	0,32	0,32
Passion Fruit Flour	0	3	6	9
Summation	100	100	100	100
Required		17.8	3100	5 - 7

Table 3: *Formulation of diets for treatment (T1) with 3% of maracuya flour growth stage.*

Source: Ulloa R (2016).

Results

Table 4 shows the cumulative weight gain of (1 to 42 days), determining a significance at 5% between treatments, which means that there are differences when adding passion fruit flour to the diet. The analysis of variance and coefficient of variation (1.91%) is reported in After having made the analysis of variance for the cumulative feed conversion was determined that there is a significance at 5% for treatments, there being significance to add to the diet, flour of passion fruit (Table 1). The coefficient of variation for the accumulated weight gain is 2.12%, being within the acceptable range in research.

Index evaluated	T0 (0% passion fruit)	T1 (3% passion fruit)	T2 (6%passion fruit)	T3 (9% passion fruit)	Significance, *
Initial weight, g.	41.8	41.7	41.5	41.6	
Final weight, g.	2123.77a	2132.31a	2065.22a	1970.30b	**
Food consumption, g.	3992.78	3992.74	4006.34	3987.53	NS
Weight gain, g.	2081.97a	2090.61a	2023.72a	1928.40b	**
Food conversion	1.92a	1.91a	1.98a	2.07b	**
Total mortality,%.	10	10	6	12	
European efficiency	233a	234a	229a	195b	**

Table 4: *Summary of the analyzed variables accumulated stage.*

*a, b, c Averages with different letters in the rows differ significantly (P < 0.05). * significance at 5%. ** significance at 1%. g: grams. NS: Not significant.*

Source: Ulloa R (2016).

The percentages of accumulated mortality for each treatment are shown, T1 (3% of passion fruit flour) and T0 (0% of passion fruit flour) are similar and the causes of death are not related to the food since in its The majority was due to causes other than diet, T2 (6% of passion fruit flour) has the lowest mortality, on the other hand, T3 (9% of passion fruit flour), presented a higher mortality. Table 1 reports that there is no significance at 5% for treatments, which means that there are no differences in the amount of food consumed when adding passion fruit flour to the diet. The coefficient of variation for the accumulated weight gain is 0.34%, which is within the range.

Figure 1 shows the behavior of the data for the European Efficiency Index using quadratic regression. In the analysis of variance is determined, determining a significance at 5% between treatments, which means that there are differences to add to the diet, passion fruit flour. The coefficient of variation for the European Efficiency Index is 3.95%, which is within the acceptable range.

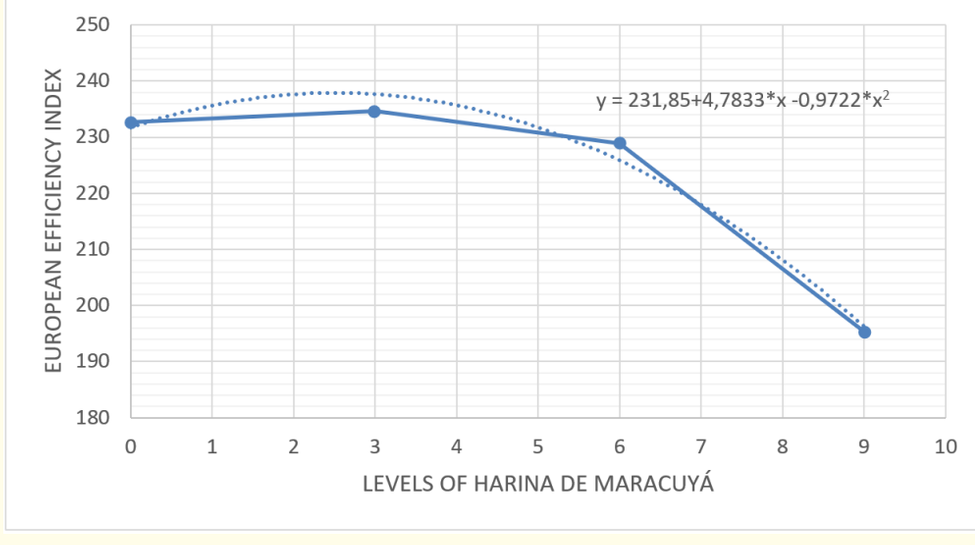

Figure 1: Comparison of the European Efficiency variable by means of quadratic regression.

The profitability figure 1, shows the calculation of the Ingalls-Ortiz Index (I.O.R.), yielding a positive index which means that production is economically viable, taking into account that an index greater than 1 is profitable production. This index shows that the T2 treatment obtained a better performance, this is due to the low mortality recorded in this treatment, therefore, a greater number of birds sold was obtained.

This index can also be compared with the European Efficiency Index (IEE) and the following interpretations can be drawn. The I.O.R. being clearly economic while the I.E.E. measures productive indexes Taking into account these data we can conclude that an I.E.E. High does not guarantee that the I.O.R. be high or on the contrary, an I.O.R. high does not mean that the I.E.E. be tall.

Index evaluated	T0 (0% passion fruit)	T1 (3% passion fruit)	T2 (6% passion fruit)	T3 (9% passion fruit)
Cost per treatment, $.	155.21	153.23	153.18	149.88
Cost per kg food, $.	0.541	0.533	0.528	0.527
Differences% between witness diet vs H.		-1.5	-2.4	-2.6
Cost per kg of channel produced, $.	1.65	1.58	1.58	1.72
Ingalls-Ortiz Index	1.13	1.17	1.18	1.08

Table 5: *Summary of the economic analysis.*

H: Flour; Kg: Kilograms; %: Percentage.
Source: Ulloa R (2016).

Discussion

The use of passion fruit flour at 3% does not affect the weight gain in broiler chickens in the initial stage because statistically similar yields are obtained to the control (Table 3). Therefore, it coincides with the research carried out by Ferreira M [5,6] which states that the substitution of 10% of maize by passion fruit residues in the diet does not affect the performance of broiler chickens, on the other hand it can be observe that with an inclusion of 6% of passion fruit in the diet the weights are affected and this is due to the fact that being this very sensitive stage where the bird requires products of easy assimilation with little fiber and being the passion fruit flour high in fiber, this is not used by the animal as a whole.

The best food conversion presents T0 (0% passion fruit flour) with a conversion of 1.53 and T1 with 1.57, it is also shown that T2 with a value of 1.59 shares significance with T1, while the last rank occupies T3 (9% of passion fruit flour) with a conversion of 1.65 (Table 3); so it is concluded that in this stage they require a low fiber food and the passion fruit flour, being high in fiber, shows a negative impact on the feed conversion, considering that the lower value obtained from feed conversion is better. Therefore, it agrees with what was referred by Aconda A [12], who states that passion fruit pulp, having a high fiber content (40.9%), may be the limiting factor for its use in high percentage of diets for birds.

Therefore, the use of passion fruit flour in the 3% and 6% growth stage, statistically produces the same weight yield as the control. In agreement with Ferreira M [5,6], the substitution of 10% of corn by passion fruit in the diet does not affect the performance of slow-growing broilers up to 70 days of age, and Mazon E [13] states that up to 5% of passion fruit flour can be included in poultry diets. Being a viable raw material for the formulation of balanced for broilers in percentages of up to 6% where the bird tolerates the fiber of this product.

So the use of passion fruit flour at 3% and 6% does not affect the feed conversion compared to the control and if we compare with the previous stage it can be shown that at this stage the most efficient in the use of nutrients from fiber diets always and when the 6% inclusion is not exceeded. For what agrees with the research carried out by Ferreira M [5,6], the substitution of 10% of maize for fruit residues of passion fruit in the diet does not affect the performance of slow-growing broilers up to 70 days of age.

The passion fruit flour between 3 and 6% of inclusion does not vary in the weight of the birds and contrasts with that reported by Ochoa [4], which states that the best digestibility is achieved with 5% passion fruit cake in the diet with enzymes obtaining 69.92%, in the same way Togashi [14] refers that the flour in levels of 4% and 8% of passion fruit seed modifies the levels of cholesterol without affecting the performance characteristics of fattening pigs, by other part. Perondi D [15], expresses in his research that it can be used in a diet up to 16% in growth and completion of pigs, and being an omnivorous animal like birds could easily deduce that levels could also be used similar, but by these research works already done in birds do not confirm this theory for it the importance of conducting experiments with each species, and even within the species should be studied by stages or ends, evidencing in this research that the inclusion of flour of passion fruit in percentages higher than 6% of inclusion shows a reduction in feed conversion and therefore in weight gain.

In the European Efficiency Index (IEE), applying the Tukey test (Figure 1) shows two ranges of significance; the T1, T0 and T2 with 234.68, 232.68 and 228.82 respectively share the same level of significance, finally the T3 with 195.31 differs statistically from the other treatments (Table 1); Díaz (2007) considers that the minimum expected number to define a good behavior is 200, T1 with 234.68, T0 with 232.68 and T2 with 228.82, statistically no differences and being over 200 is considered acceptable, and it can be concluded that the use of passion fruit flour does not alter this index up to 6%, the T3 statistically is different from the other treatments, proving with this index that the inclusion of passion fruit flour at 9% is not viable in the diet of chickens for fattening, being corroborated by Mazón C [16] stating that the passion fruit flour has high values in terms of acid detergent fiber (69.29) and neutral detergent fiber (72.27), referring to this it can be shown that the Passion fruit flour is high in fiber, which is why it cannot be included in high percentages in diets for broilers, in figure 1, the productive behavior can be evidenced according to the level of inclusion. n observed that from 6% percentage of inclusion of flour passionfruit production rates start to decline [17-23].

Conclusions

Passion fruit flour at a level of 9% inclusion in broiler diets statistically influences the zootechnical parameters by reducing them, therefore its use is not recommended at this level, in percentages of 0%, 3% and 6% presented statistically similar results in the variables analyzed; therefore, from a nutritional point of view, this raw material does not increase or decrease the zootechnical parameters at the indicated levels.

In the weight gain, similar yields were obtained among the T1 treatments (3% passion fruit flour) reaching weights of 2090.61g with a cost per kilogram of meat of $ 1.58 and T2 (6% passion fruit flour) with 2023.72g at a cost similar to the previous one of $ 1.58, compared to the witness (0% passion fruit flour) with 2081.97g and a cost per kilogram of meat of $ 1.65, finally the T3 (9% passion fruit flour) 1928.40g with a cost per kilogram of meat of $ 1.72.

Passion fruit flour at these levels does not influence feed conversion. The T3 treatment (9% passion fruit flour) showed a feed conversion of 2.07, so it is not recommended to use this percentage.

The European Efficiency to be an index that is calculated from the previous ones, similar values were obtained between the treatments T0 (0% flour of passion fruit), T1 (3% of passion fruit flour) and T2 (6% passion fruit flour) with 233, 234 and 229 respectively; therefore, European efficiency is not affected if passion fruit flour is used at these levels.

Economically the T2 treatment (6% passion fruit flour) is better. This is due to the low percentage of mortality that this treatment presented. On the other hand, the formulation of diets with passion fruit flour reduces the cost of these in an ascending way in relation to the amount of passion fruit that is included, as shown below: T1 (3% passion fruit flour), 1.48%, T2 (6% passion fruit flour) 2.40%, T3 (9% passion fruit flour) 2.59.

The passion fruit flour can be used in diets for broilers in growth stage and fattening can be included in the formulation of diets up to 6% without affecting the zootechnical indexes, in addition the effectiveness of exogenous enzymes on this product, we could also study the effect of passion fruit flour on liver function, evidencing a lower presence of abdominal fat in chickens treated with passion fruit flour.

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